CHEMICAL CORPS

MEDICAL DIVISION REPORTS

No. 158

EFFECTS OF G AGENTS ON MAN: CLINICAL OBSERVATIONS

by

Ernest C. Brown, Jr.

ARMY CHEMICAL CENTER • MARYLAND

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MEDICAL DIVISION
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MARYLAND

CMLEM-52

[redacted]
19 Oct 48 [redacted]
Date Initial

By Authority of
Chief, Medical Division

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Publication Control No. 5030-158

[redacted]
CANCELLED
[redacted]

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ABSTRACT

OBJECT.

Between July 1947 and July 1948 there have been seven recorded cases of G casualties at the Army Chemical Center, Maryland, four at field trials run at Suffield, Alberta, Canada in the fall of 1947, and one at Dugway Proving Ground, Utah. Two of the reports from the Army Chemical Center are so incomplete they will not be included in this report. These accident reports consist of a standard form (Appendix) filled out by Medical Officers assigned to Medical Division, Army Chemical Center, Maryland, who were directly responsible for the men under exposure to the agent. It is estimated that at least six different officers filled in the reports, making comparisons of the degree of severity of signs and symptoms difficult to evaluate. Since the number of cases seen is small, no attempt will be made to tabulate the cases; but a brief description of each case will be presented.

RESULTS.

Case records of 10 G casualties are presented and reviewed.

CONCLUSIONS.

1. The human G casualties recorded at the Army Chemical Center are mild with few objective clinical or biochemical findings.

2. Psychological reactions are the outstanding feature.

RECOMMENDATIONS.

1. That in the event of future G-agent casualties, certain routine laboratory procedures be carried out as outlined in the appendix.

2. That further study be made of the psychological reactions among healthy young men having no knowledge of, or previous experience with, G agents.

Medical Division Report No. 158

Effects of G Agents on Man: Clinical Observations

I. INTRODUCTION.

A. Object.

Between July 1947 and July 1948 there have been seven recorded cases of G casualties at the Army Chemical Center, Maryland, four at field trials run at Suffield, Alberta, Canada in the fall of 1947, and one at Dugway Proving Ground, Utah. Two of the reports from the Army Chemical Center are so incomplete they will not be included in this report. These accident reports consist of a standard form (Appendix) filled out by Medical Officers assigned to Medical Division, Army Chemical Center, Maryland, who were directly responsible for the men under exposure to the agent. It is estimated that at least six different officers filled in the reports, making comparisons of the degree of severity of signs and symptoms difficult to evaluate. Since the number of cases seen is small, no attempt will be made to tabulate the cases; but a brief description of each case will be presented.

B. Authority.

Authorized by the Chief, Chemical Corps, under Project 4-59-12-07, Clinical Investigation and Treatment of Chemical Casualties in Man, Cml C Research and Development Program for fiscal year 1949.

II. HISTORICAL.

See Medical Division Report No. 159, Effect of G Agents on Man, Status Summary (1).

III. EXPERIMENTAL.

A. Results.

1. CASE 1: (b) (6), 32 year old white male, Chief, Gassing Section, Army Chemical Center, Maryland.

a. Exposure: The accident occurred while working in front of a well-ventilated laboratory hood on 23 July 1948. He wore no protective clothing, mask, or glasses. He was attempting to loosen a glass stopper from a bottle containing GB located inside the hood. The stopper slipped from his hand and glanced against his left wrist. No liquid contamination was apparent. He turned to the sink and immediately washed his hands and forearms with soap and water. Within a minute of the accident he experienced the following symptoms:

b. Signs of Symptoms: First sensation was constriction in his chest with mild wheezing followed rapidly by dimness and blurring of vision and yellow vision. After 5 to 10 min. he felt "woozy". When first seen by the Medical Officer about 3 to 5 min. after the accident, his pupils were fixed to light and on accommodation and about 1 mm. in diameter. Chest clear. No gastrointestional symptoms. No fasciculation. Apprehensive.

c. Treatment: One milliliter of 1/10% atropine sulfate intravenously was given 5 min. after exposure. Chest symptoms had already cleared, but visual symptoms and feeling of weakness persisted.

d. Progress: Returned home and went to sleep. Awoke in 1½ hr. with same feeling of tightness in his chest, and this was relieved by sitting on the edge of his bed. A medical officer was called who found his pulse was 66, blood pressure 90/54 prone, and 92/60 sitting. Lungs clear, pupils miotic. Given 1.3 mg. atropine sulfate by mouth and told to take Delvinol grains 1½, but this latter was not done. At 0200 of the morning following the accident and 10 hr. after exposure, the patient's wife says he awoke singing about snakes. Memory of events during the 20 hr. following exposure was poor. Remembers no bad dreams, easily fatigued with fairly marked lassitude. Three days following exposure pupils still contracted but reacted slightly to light. Continues to feel weak. Blood pressure 116/66.

e. Laboratory:

Cholinesterase determination. Concentrations are expressed as per cent of control values in the same individual.

Date	Red Blood Cell	Plasma
23 July	-	98%
26 July	109%	104%
2 August	120%	98%

EKG's on 26 July and 2 August showed no definite abnormality.

f. Evaluation of Symptoms: The miosis was definite and incontestable, but this was the only objective finding other than the lowered blood pressure which might have been due to a fainting reaction or perhaps to an acetylcholine effect. Just how much of the symtomatology was psychic is impossible to say; but with no change in the red blood cell cholinesterase, it is likely that some part of the symptom complex has a psychogenic basis.

2. CASE 2: (b) (6) [redacted] 22 year old white female, Technician, Gassing Section, Army Chemical Center, Maryland.

a. Exposure: 22 July 1947. Had been pipetting GA with a rubber bulb under a laboratory hood during the day. No notice was recorded of a GA odor. No protective clothing, mask, nor glasses worn.

b. Signs of Symptoms: About 4 hr. after exposure patient complained of running nose, sensation of pressure in the chest, difficulty of accommodation, and blurring of vision. About 6 to 8 hr. after exposure she complained of low, crampy abdominal pain with nausea and mild frontal headache. Physical examination revealed no miosis, but the left pupil reacted very slowly to light and on accommodation. Right pupil was normal. There was a moderate increase in nasal secretions.

c. Treatment: One milliliter of 1/10 per cent atropine sulfate was given intravenously an unknown length of time after exposure with immediate relief of chest symptoms, but the gastrointestinal symptoms including nausea, vomiting, and abdominal pain continued for the next 2 days.

d. Laboratory: No cholinesterase determination available.

e. Evaluation of Symptoms: This patient had been exposed to G twice previously, the last accident being 5 wks. before the above. At that time her symptoms were headache, miosis and abdominal cramps, but unfortunately the accident records of both these exposures are not available. This patient was presumably exposed to GA vapor; however, the outstanding symptoms after the exposure of 22 July 1947, were gastrointestinal with no miosis, although visual symptoms were present.

3. CASE 3: (b) (6), 29 year old white male, Technician, Toxicology Section, Army Chemical Center, Maryland.

a. Exposure: 24 June 1948. While leaning over a micrometer needle injecting GB subcutaneously into a goat, he accidentally took several breaths of vapor and felt an immediate tightness in his chest and experienced excessive perspiration. On physical examination there was no definite miosis. There was a questionable prolonged expiratory phase to his breath sounds without any rales in the chest. He seemed nervous and apprehensive. On the evening following the exposure he experienced several mild spells of shortness of breath. There were never any visual symptoms.

b. Treatment: Given 1.25 mg. of atropine sulfate orally with marked improvement of the chest symptoms.

c. Laboratory: Cholinesterase determinations 24 June 1948. Red blood cell 0.67 units, plasma 1.13 units. No control values, but these are within normal limits (0.59 - 0.95u) on an absolute unit basis.

d. Evaluation of Symptoms: This is another example of a case exposed to G vapor with pulmonary symptoms and no eye signs or symptoms and with normal red blood cell cholinesterase. In this case there are no objective findings whatsoever.

4. CASE 4: (b) (6), 23 year old white male, Animal Handler, Army Chemical Center, Maryland.

a. Exposure: 4 September 1947. During a field test for GA, he was exposed to contaminated pigeon cages 2 hr. prior to the discovery of any toxic effects.

b. Signs and Symptoms: Was observed to have moderate bilateral miosis which was asymtomatic and hence was given no treatment at this time. Returned 36 hr. later complaining of retrobulbar pain, and the same pupillary constriction was found. This was relieved by instillation of 1% homatropine in both eyes. He was seen again 4 days later, and at this time the eyes were normal.

c. Evaluation of Symptoms: This patient represents the mild field exposure to GA resulting in only eye signs and symptoms. No laboratory studies were done.

5. CASE 5: (b) (6), 32 year old white male, Toxic Gas Handler, Army Chemical Center, Maryland.

a. Exposure: 9 July 1947. While participating in a field test wearing complete protective clothing (no details given), he complained of retrobulbar headache 2 hr. after the static explosion of the bomb. He was found to have moderate right unilateral miosis with no chest symptoms. He was treated with an ophthalmic disc of atropine sulfate in the right eye resulting in mydriasis 15 min. later and complete relief of his headache. He was discharged. Three hours later he returned complaining of tightness in his chest, mild cough, excessive bronchial secretion and dyspnea. He was treated with 0.3 mg. atropine sulfate (route of administration unknown) and was discharged ½ hr. later asymptomatic. A fissure was found over the right eye piece of his gas mask. No laboratories studies were done.

b. Evaluation of Symptoms: This patient is known to be apprehensive and nervous, but the right unilateral miosis was definite. There may well have been a psychic factor in the chest symptoms which appeared later.

c. Second Exposure: The same patient was exposed again on the 29th of October. This time he entered the field 3 days after a shoot without mask or protective clothing. Five hours later he came in complaining of a headache across the right side of his head. There were no signs or symptoms other than a recorded grade 1 photophobia. He was given no treatment.

d. Evaluation of Symptoms: Certainly the photophobia cannot be accounted for. It is believed that psychic factors played a large, if not a complete, part of this last picture.

6. CASE 6: (b) (6), 33 year old white male, Technician, Suffield, Alberta, Canada.

a. Exposure: 24 September 1947. Participated in a field trial while he was protected with butyl rubber pants and mask. He was exposed in a down-wind cloud for the first 10 min. after the bomb burst. He visited the same area 10 min. every hour thereafter for 14½ hr.

b. Signs of Symptoms: Thirty hours after the explosion of the bomb he removed his protective clothing and found a "bright red blotchy macular rash" over parts of his body not protective by the butyl rubber pants or mask. The report does not mention the nature of the clothing over the rest of the body. There were no eye, respiratory, or gastrointestinal signs or symptoms of G poisoning. After 3 or 4 days the rash faded away. No treatment was given. The patient worked in the chemical laboratory for 2 days following the above test, and on the 2nd day, for a short time, handled contaminated tubing in spite of a strong odor of GA. He soon noticed nausea and malaise which forced him to leave the room. Over the ensuing weekend he felt unusually logy and fatigued. No signs or symptoms of G toxicity were found on the following Monday. There were no laboratory determinations.

Six days later on the 30th of September he again participated in a similar field test wearing the same clothes and going into the contaminated area at the same intervals.

c. Signs and Symptoms: On removing his clothing 15 hr. after the bomb burst he noticed the same rash in the same distribution as above. This time the rash faded in 24 hr. There was also a bilateral miosis which was completely asymptomatic. There were no other signs or symptoms noted. There was no treatment, and no skin tests were done. This patient had a past history of hay fever and hives. No other details are known.

d. Evaluation of Signs and Symptoms: It is interesting that a patient with a past history of allergic skin disease developed a rash on the parts of his body not protected by butyl rubber. As far as is known, this has not been described previously, however since there were no skin tests to extremely small amounts of G or to the clothing that the patient was wearing at the time of the test, no definite conclusions can be drawn.

7. CASE 7: (b) (6), 34 year old white male, Suffield, Alberta, Canada.

a. Exposure: 24 September 1947. Symptoms came on 30 min. after entering a laboratory containing instruments which had been used in a field trial 24 hr. previously.

b. Signs and Symptoms: A sensation of tightness of the chest with mild cough and dyspnea were noted 30 min. after entering the room. There was a moderate bilateral miosis, moderate nasal congestion with rhinorrhea. Four hours later the patient complained of a retrobulbar headache. No treatment was given. There were no laboratory studies. The patient was seen again 10 days later and was completely asymptomatic.

c. Evaluation of Symptoms: This patient represents a laboratory exposure to a small amount of GA remaining on equipment which had been contaminated 24 hr. previously.

8. CASE 8: (b) (6), 35 year old white male, Suffield, Alberta, Canada.

a. Exposure: 3 October 1947. On the morning of the test the patient had been working in the field which had been used 3 days previously for a GA shoot. At this time he wore no mask and no protective clothing in spite of the fact that there was a slight odor of the agent. During the afternoon of the same day in butyl rubber pants and mask the patient entered the field immediately after explosion of a GA bomb and remained in the field for 20 min. After coming off the field he was found to have bilateral mild asymptomatic miosis. He was given no treatment and 3 days later his eyes were perfectly normal.

b. Evaluation of Symptoms: It was thought by the Medical Officer in charge that the miosis resulted from working unprotected in the field during the morning before the shoot. However, no mention is made of examining the gas mask worn in the afternoon for possible leaks.

9. CASE 9: (b) (6), 32 year old white male, Suffield, Alberta, Canada.

a. Exposure: 31 October 1947. He was working on equipment in a field 96 hr. after the last bomb burst. It is said that a definite odor of GA was present, but no mask was worn.

b. Signs and Symptoms: Forty-five minutes after entering the field the patient complained of tightness in the chest with mild cough and dyspnea on exertion. He was found to have a moderate bilateral miosis. No treatment was given. He was seen 3 days later, and at this time his eyes were normal.

c. Evaluation of Signs and Symptoms: This patient represents a mild exposure to GA 96 hr. after the field had been contaminated with the agent, presumably in rather cool weather.

10. CASE 10: (b) (6), 35 year old white male, Toxic Gas Handler, Dugway Proving Ground.

a. Exposure: On Friday, 16 July 1948, patient in full butyl rubber protective clothing and mask entered field at 0600 immediately after air burst of GA bomb and spent about an hour repairing wires severed by shrapnel. He left the field asymptomatic and did not return until 0200 of the next morning, July 17. At this time he drove onto the field in a jeep protected only by a mask and butyl rubber gloves to check recording instruments. All were intact, and he did not have to leave the jeep.

b. Signs and Symptoms: After returning to his barracks, and about 10 to 20 min. after entering the area, he experienced a sensation of tightness in his chest with wheezing. Shortly after this he began to "slobber" profusely. He described with his hands a puddle of saliva about 6 to 8 in. in diameter. He drank a cup of coffee and experienced "drawing" pains in his epigastrium, no vomiting. There were no visual symptoms, headache, rhinorrhea. The salivation continued for several hours until it disappeared spontaneously. The feeling of tightness in the chest has continued to the present (19 days) following exposure. No cough or fever. The abdominal pain has also continued and comes on after ingesting a small amount of food or liquid. Appetite is very poor. No fasciculations or bad dreams. Two days after exposure his bowels became loose and have remained loose until the present with 2 to 3 movements a day. He also complains of tenderness along the lower ventral edge of the thorax, but says that this may possibly be due to strenuous jeep rides. Further, since this episode, he complains of feeling "stinking" with marked lassitude, ease of fatigue, anorexia, loss of interest in any daily activity.

He was recalled from Dugway on about 23 July to return to Army Chemical Center because of illness at home. This, plus the fact that the patient repeatedly voiced his intense dislike for Dugway, should be taken into consideration when evaluating the subjective complaints following the incident.

He was not seen by a Medical Officer in Dugway until the third day after the exposure. At this time he was found to have no eye signs whatsoever and his chest was clear. He was not given any treatment and was allowed to work setting up equipment for the field trials; but he was not allowed to be exposed to the agent.

c. Physical Examination: On August 4, 1948. Pulse 68. Blood Pressure 108/68.

Low average intelligence with rather poor recall. Oriented in all spheres.

d. Eyes: Pupils 2 - 3 mm. in daylight of room, reacted well to light and on accommodation. Visual acuity grossly normal. Conjunctivae clear. Extra-ocular movements normal. No salivation or rhinorrhea.

Chest showed a few scattered wheezes, but was otherwise not remarkable. There was an occasional premature heart beat.

Abdomen negative to palpation, peristalsis normal.

Muscle strength in arms and legs grossly normal with no myasthenic effect. Reflexes normal.

e. Laboratory:

Red blood cell cholinesterase determinations

2 July	0.89 units	
9 July	0.81 units	
19 July	0.60 units	(26% decrease over control on 9 July)
4 August	0.83 units	

EKG: Normal.
Barium swallow: No cardiospasm, normal peristalsis with good filling of the duodenal cap.

f. Evaluation of Symptoms: It is of interest that his red blood cell cholinesterase had returned to normal 19 days after exposure. It should also be pointed out that the gastrointestinal symptoms may well have a psychic background incidental to the exposure to G. The patient's wife was pregnant back in Baltimore and not getting along as smoothly as might be desired. She finally had a miscarriage and he was called home. Further, the patient admits to drinking 8 to 10 cups of coffee and smoking 2 packs of cigarettes a day. However, the salivation and fall in red blood cell cholinesterase are definite. This patient represents a mild-to-moderate field exposure to GA with chest symptoms and salivation but without any eye symptoms.

IV. DISCUSSION.

All of the above cases are obviously mild with few objective findings. Five of the ten cases show mild-to-moderate eye signs; two cases have gastrointestinal symptoms; and six have chest symptoms, but signs were not present. Of three cases in which cholinesterase determinations were performed, one showed a 26% drop from the control value, and this had risen to normal 16 days later. The outstanding feature of these cases appears to be the psychological reactions, which are disabling from several days to several weeks, even with such small exposures. However, it is also apparent that these are most marked in those who have had the greatest experience with G agents and who are best aware of its potentialities. Whether a group of young men having no experience or knowledge of G would show such a reaction to a small exposure would be

valuable knowledge, since morale and initiative among combat troops would be seriously affected if this psychological effect is a true fact.

V. CONCLUSIONS.

1. The human G casualties recorded at the Army Chemical Center are mild with few objective clinical or biochemical findings.

2. Psychological reactions are the outstanding feature.

VI. RECOMMENDATIONS.

1. That in the event of future G-agent casualties, certain routine laboratory procedures be carried out as outlined in the appendix.

2. That further study be made of the psychological reactions among healthy young men having no knowledge of, or previous experience with, G agents.

VII. BIBLIOGRAPHY.

Dill, David B., Effects of G Agents on Man: Status Summary, Medical Division Report No. 159, 24 August 1948.

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APPENDIX

"G" CASUALTY EMERGENCY REPORT*

Date _____ Time _____ Place _____

Name _____ Grade _____ Where Employed _____

Chief Complaint: _____ Severity _____

E.E.N.T.: Eyes: miosis___; injection___; conjunctival hemorrhage___; blurring of vision___; fall in intraocular tension___; tearing___; blepharospasm___; retrobulbar pain___; pain on focusing on near objects___; ciliary tenderness___; photophobia___; Nose and Throat: nasal congestion___; rhinorrhea___; salivation___; light reflex .

Respiratory: tightness in chest___; pain in chest___; cough___; dyspnea___; secretion___; auscultatory findings _____

Cardiovascular: pulse rate___/min.; type of pulse _____

Gastrointestinal: anorexia___; nausea___; abdominal cramps___; vomiting___; diarrhea___.

Neuromuscular: headache___; location _____; nervousnes_____; tremor_____; fasciculation_____; drowsiness_____; weakness_____.

Remarks: (include here: time of onset after exposure; type of exposure-inhalation or contact; discussion of any of the above symptoms): _____

Treatment and Response: _____

Disposition: _____

Reason for casualty: faulty mask___; improper technique___; carelessness___;

Suggestions: _____

*(Grade signs and symptoms: mild-1 ; moderate-2 ; severe-3 ; maximum-4)

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APPENDIX (contd)

"G" CASUALTY "FOLLOW-UP" REPORT

Date	Time	Remarks and Treatment

EA Form 8-24
(21 Aug 47)

It is recommended that the following laboratory studies be incorporated into this form and carried out in future G agent casualties:

Laboratory findings: Complete on day of exposure if possible.

1. Blood cholinesterase:

	RBC	Plasma
a. Control (when available):		
b. Immediately following exposure:		
c. 1 day following exposure:		
d. 7 days following exposure:		
e. 14 days following exposure:		
f. 21 days following exposure:		

2. EKG:

3. EEG: When there is any indication whatsoever.

4. Electromyograms: If there is any decrease in grip, presence of a myasthenic effect, or of lassitude.

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Medical Division Report No. 158.
Effects of G Agents on Man:
Clinical Observations.

SUBMITTED:

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SUPERVISED BY:

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Chief, Pathology Section

Authority:

Project No.: 4-59-12-07
Test Program No.: None

APPROVAL RECOMMENDED:

(b) (6)

Chief, Clinical Research Branch

Experimental Data:

Date Started: 23 July 1948
Date Completed: 20 August 1948
Notebook No.: None

(b) (6)

Chairman, Editorial Committee

APPROVED:

(b) (6)

for DAVID B. DILL
Scientific Director

Typed: 19 October 1948
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Colonel, Medical Corps
Chief, Medical Division

CMLEM-52
Publication Control No. 5030-158

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